Advant® OCS
with Master software

Installation Rules

User's Guide
for compliance with the EMC requirements

Use of **DANGER**, **WARNING**, **CAUTION**, and **NOTE**

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DANGER	Hazards which could result in severe personal injury or death
WARNING	Hazards which could result in personal injury
CAUTION	Hazards which could result in equipment or property damage
NOTE	Alerts user to pertinent facts and conditions

Although **DANGER** and **WARNING** hazards are related to personal injury, and **CAUTION** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **DANGER**, **WARNING**, and **CAUTION** notices.

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Chapter 1 Introduction

1.1 General

General modern electronic control systems are, or may be, sensitive to different types of interference. Advant OCS is a modular system that can be put together in different ways. It is therefore important to choose the correct units and to put them together in the right way to ensure that interference does not occur.

Installation Rules is written to facilitate the work of system configuration for interference-free operation and for satisfying of the legal requirements laid down in EMC Directive 89/336/EEC.

This book is valid from the EMC point of view for all Advant OCS systems.

It gives the basic rules generally applicable and establish the principles of grounding and answer the questions of **when** a piece of equipment, circuit or a cable shield should be grounded and **why** it should be grounded. The particular product documentation describe the physical installation work to be done.

1.2 Related Documentation

Related documents are listed below.

Table 1-1. Related Documents for Installation Rules

Manual	Ordering No.	Description
Interference - free electronics	3BSE 000 877R0001 (Swedish version 3BSE 000 877R0002)	Philosophy, theory design and applications of EMC on equipment and systems. Applicable to Advant OCS.

Chapter 2 Installation Rules

2.1 Equipment Design

The signal processing electronics in the Advant OCS products is normally grounded to chassis and all interference suppression for external signals refers to chassis. For galvanically isolated units a capacitive coupling to ground is normally provided.

If an Advant OCS system turns out to be sensitive to interference of this type, there is probably a component in the system that is not correctly grounded or wiring that is incorrectly routed, if all the hardware is of the approved version. In these cases, the installation must be checked, preferably by means of an interference test, before other measures are taken.

The potential of the installation ground must be stable and well-defined, even in the event of ground faults in low- and high-voltage equipment or lightning strikes.

2.1.1 Grounding Rules

For interference free operations it is important that the installations is made in such a way that good grounding of interference suppression arrangements is maintained.

- All components - backplane, power supply units, power supply filters where applicable, connection units, modems and grounding bars - must be connected directly to chassis with screws (not with long wires). The best technique to ensure a good electrical contact is to use thread cutting crews or screws with studs under the head.

  Special measures must be taken in cabinets other than ABB VSH, MNS, VSG and RE series. See Section 2.1.2 Non-ABB Cabinets.

- Parts of cabinets or enclosures that are used as a reference ground (chassis) must have good and permanent electrical bonding. Painted or anodized parts must also have good ground bonding. This can be achieved, for example, by scraping the surfaces or using thread-cutting screws; in aluminum the only way to achieve bonding is with thread-cutting screws.

2.1.2 Non-ABB Cabinets

Certain cabinet types on the market are very poor from the interference viewpoint, since most of the parts are assembled with coats of paint between them. It is necessary to make many extra short connections between the parts of the cabinet to achieve very low impedance.
To achieve this, the load-bearing part that is welded together must be identified and all other metal parts must be bonded to it with short wires (2.5 mm^2). Large pieces of sheet metal must be bonded with four wires and small pieces with two wires.

Aluminum bars and racks must be bonded to the chassis in a similar way. It is also possible to use captive nuts with special teeth that make permanent connections. See Figure 2-1.

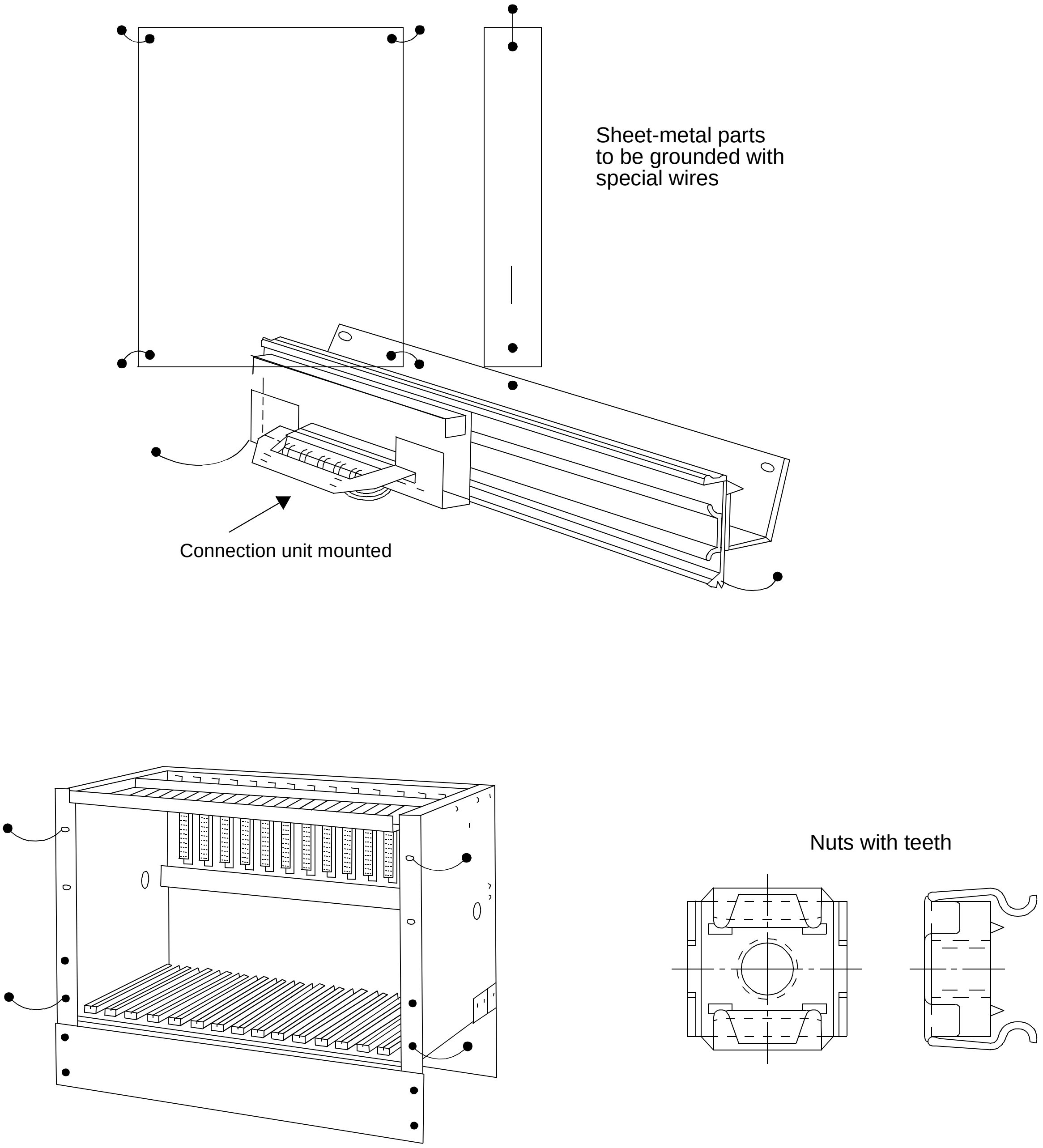


Figure 2-1. Permanent Ground Bonding Connections in Non-ABB Cabinets

2.2 Description of the System

Standard Advant OCS products are described in particular product documentation.

Significant components referred in this Installation Rules belonging to the S100 I/O system are illustrated in Figure 2-2 and Figure 2-4.

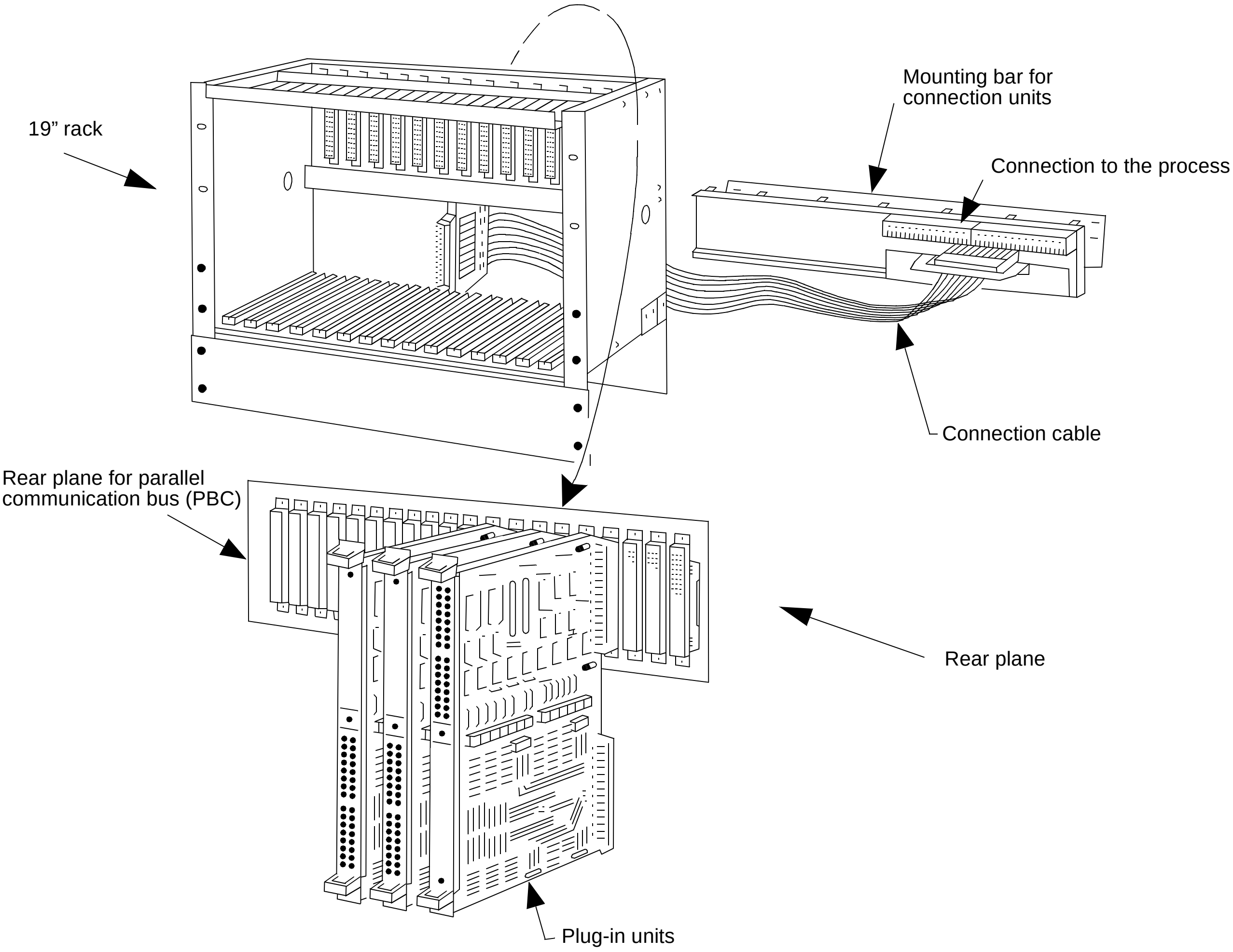

Mounting bar for connection units
19” rack
Connection to the process
Connection cable
Rear plane for parallel communication bus (PBC)
Rear plane
Plug-in units

Figure 2-2. Components of Advant OCS

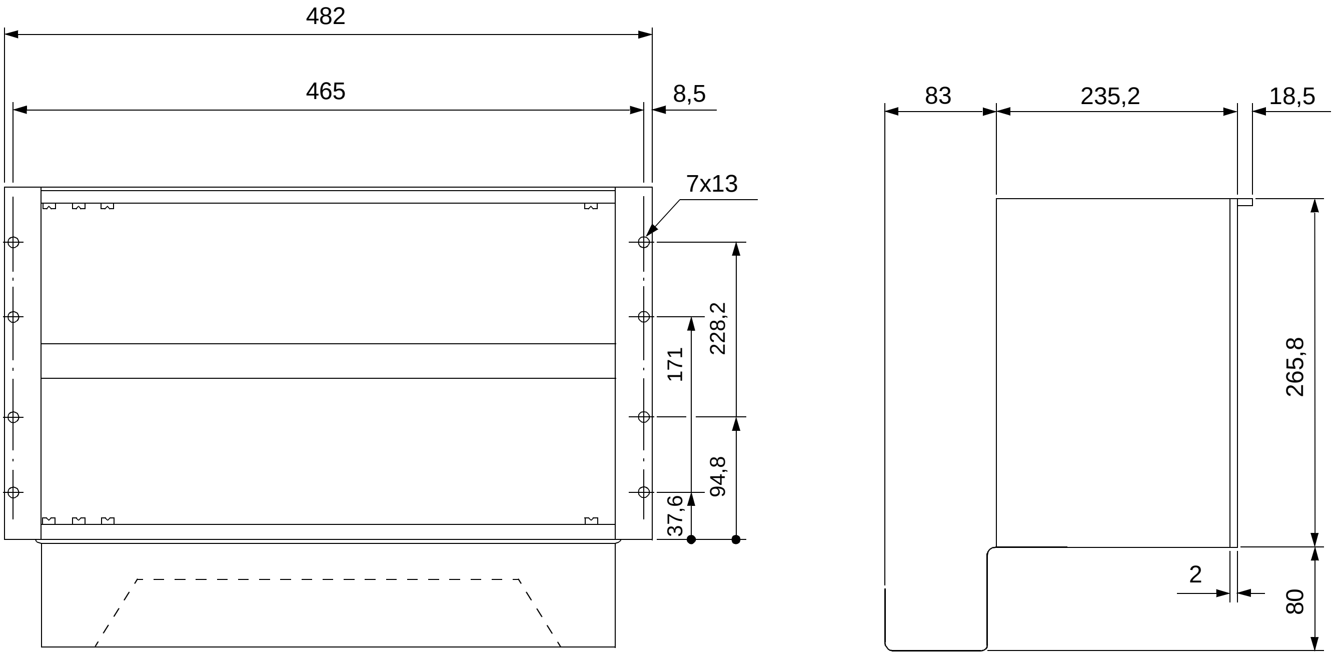


Figure 2-3. Dimension of the Rack

The mounting rail comes in two variants, 19” and 24” width. The mounting rail consists of a fixing rail (aluminum extrusion) and a cable trunk as shown in Figure 2-4. Connection units are mounted on the mounting rail.

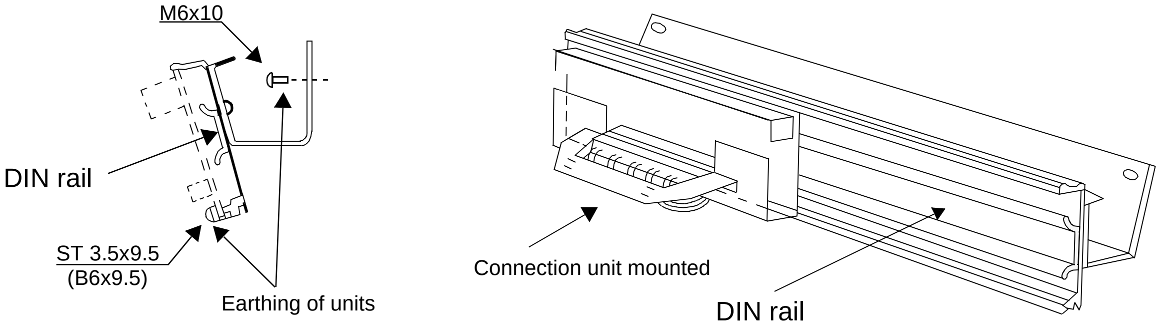


Figure 2-4. Principle of the mounting Rail with Connection Unit

2.3 Interference Suppression with Respect to the Process

In the S100 I/O system, interference suppression is obtained on the connection unit by means of overvoltage protection (varistors, zener diodes, hf capacitors etc.); see Figure 2-5.

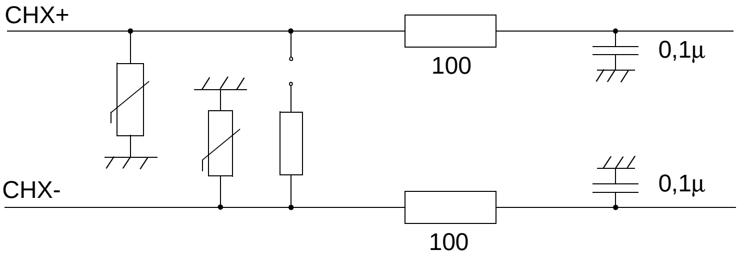


Figure 2-5. Overvoltage Protection on Connection Units

Interference currents are diverted directly via varistors and via hf capacitors to a rigid zero volt plane of the connection unit and by means of the screws A, B and C through the mounting rail and the cable duct to the chassis and thus to the ground line network. It is of the utmost importance that all screws are of the correct self-tapping type and give good contact.
Long screws must not be used, since no transition is obtained between the tin surface and the head of the screw; see Figure 2-6.

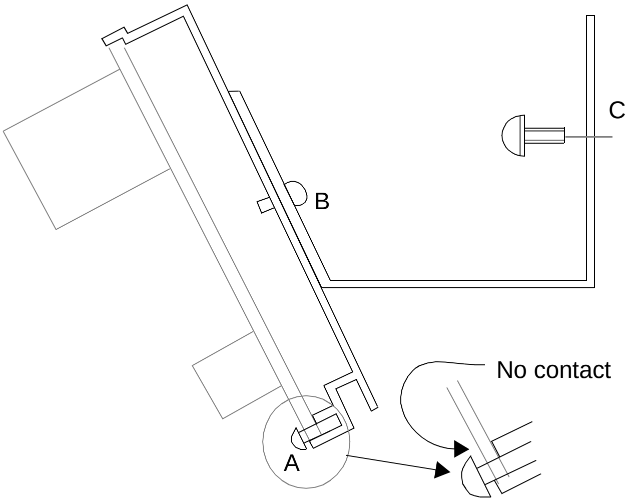


Figure 2-6. Incorrect Connection: Screw Too Long

The bonding between the aluminum bar and the cable duct (back plane) of the system must be established with self-tapping screws, since aluminum oxidizes, and connections that do not involve thread cutting become insulating after a time. It is of the utmost importance to use tapered self-tapping screws, particularly where there are painted surfaces, since only such screws guarantee permanent connection. Figure 2-7 shows how the current flows from the connection unit to the chassis and to the ground line network.

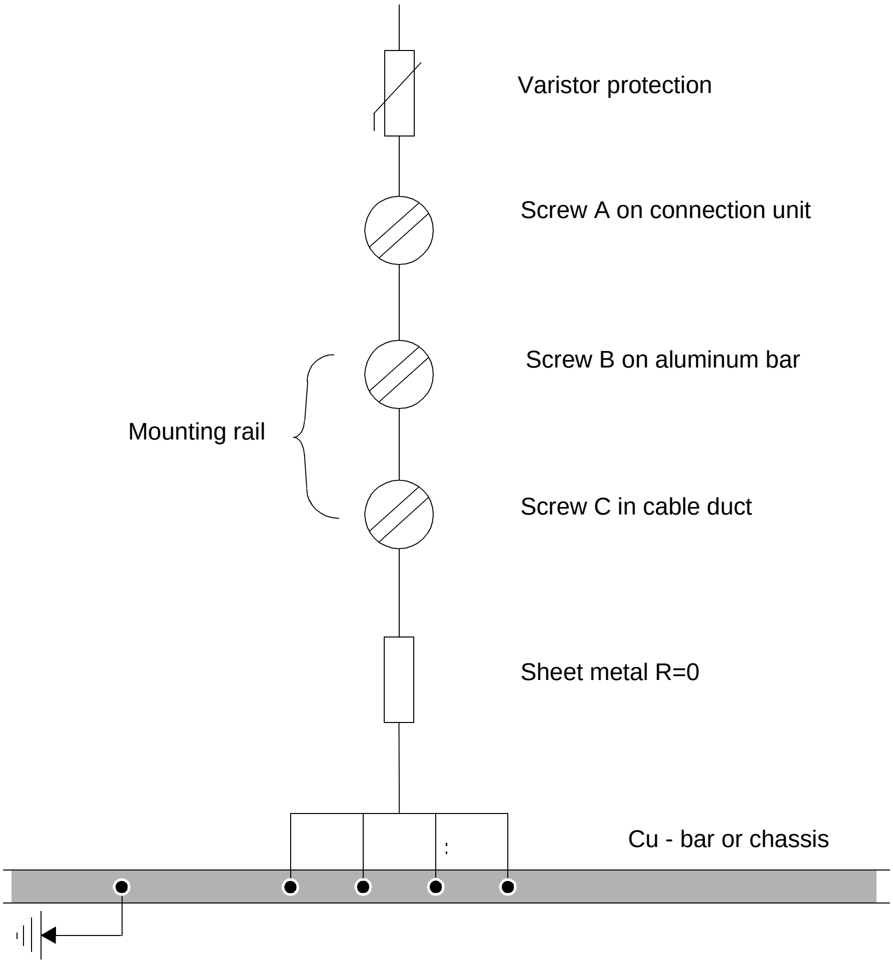


Figure 2-7. Equivalent Diagram for Interference Currents

It is important to understand this function in order to take part in the design of main parts of the Advant OCS equipment or in their electrical and mechanical assembly.

2.4 Apparatus Cabinets

From the viewpoint of interference, an adjacent cabinet, belonging to the same system, must have a permanent electrical connection and must be connected via a copper bar.

The connection units contain interference suppression circuits. For this reason, it is **extremely important** that incoming external cabling and cabling between connection units and I/O boards is routed on separate sides of the cabinet in accordance with the instructions in Figure 2-8. Cables to and from connection units must never be incorporated in one and the same cable harness, since this defeats the interference-suppression function of the connection units.
As example, in cabinets with the frame hinged on the left, incoming external cabling is therefore routed on the right-hand side of the cabinet.

Figure 2-8 shows the principles of the design of a standard apparatus cabinet.

Both sides must be fitted with support bars to which cabling can be anchored. For internal cabling, the support bars are placed level with the bottom edges of the subrack (cable duct).

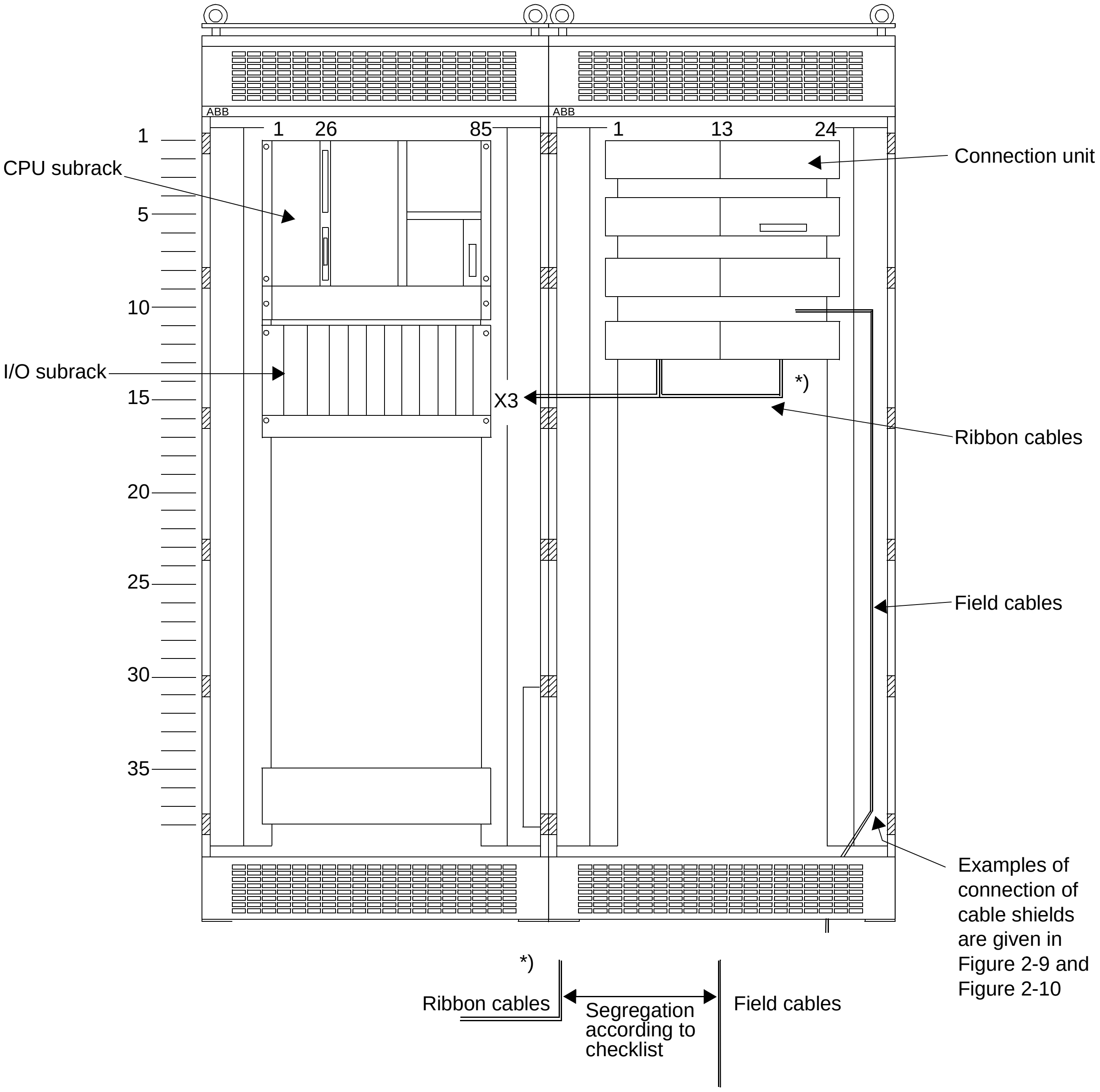


Figure 2-8. Example of Apparatus Cabinet

External Cables entering the cabinet are preferably anchored to the horizontal mounting bar close to the bottom of the cabinet. If a conventional cabinet is used the attachment of the cable shield and anchoring of the cable is co-ordinated, se Figure 2-10. If a radio proof cabinet is used the sealing and connection of cable shields, which are supposed to be grounded in the cabinet, are arranged according to Figure 2-9. The cables are anchored then unstripped in the mounting bar se Figure 2-10.

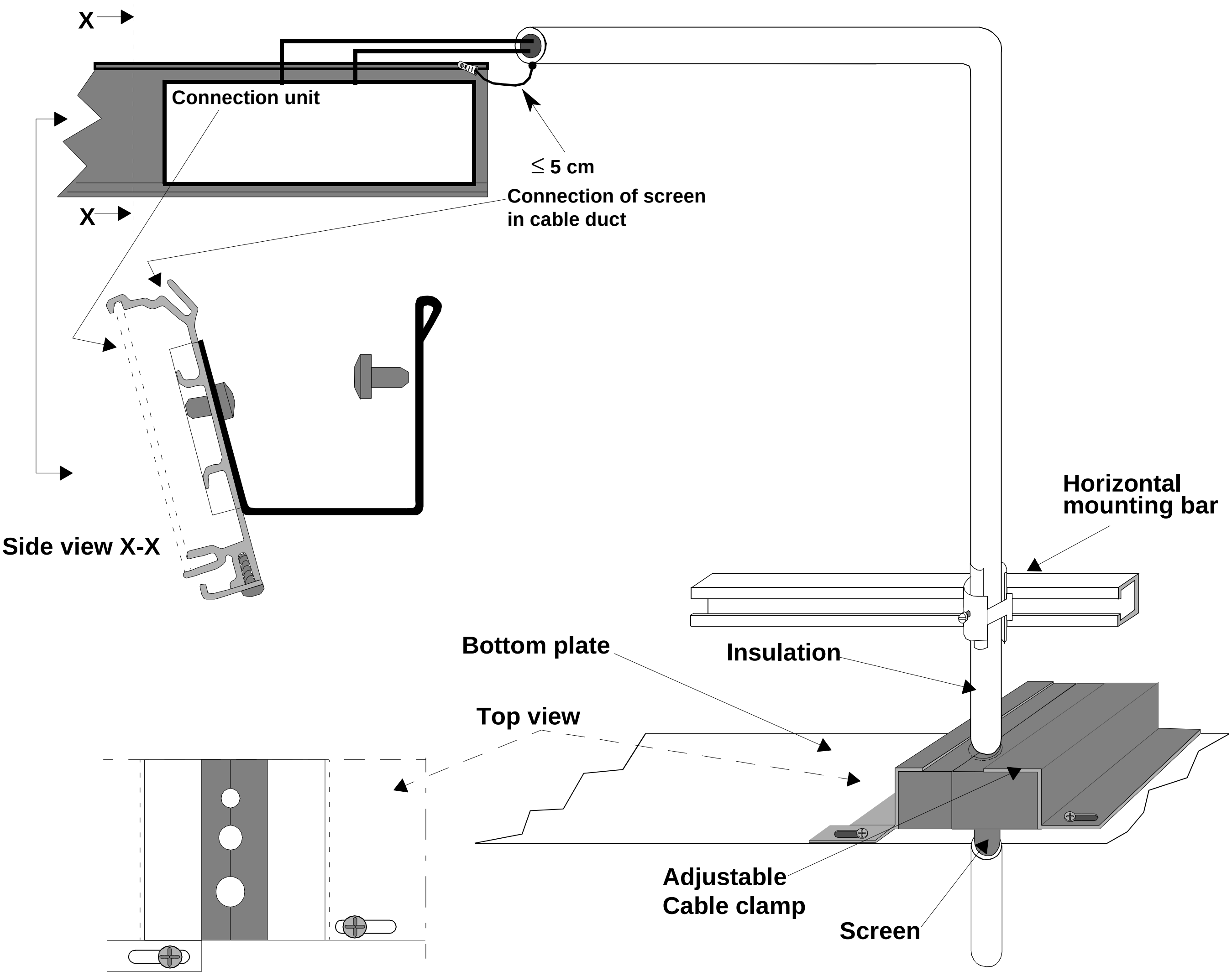


Figure 2-9. Sealing of Field Cables in a Radio Proof Cabinet

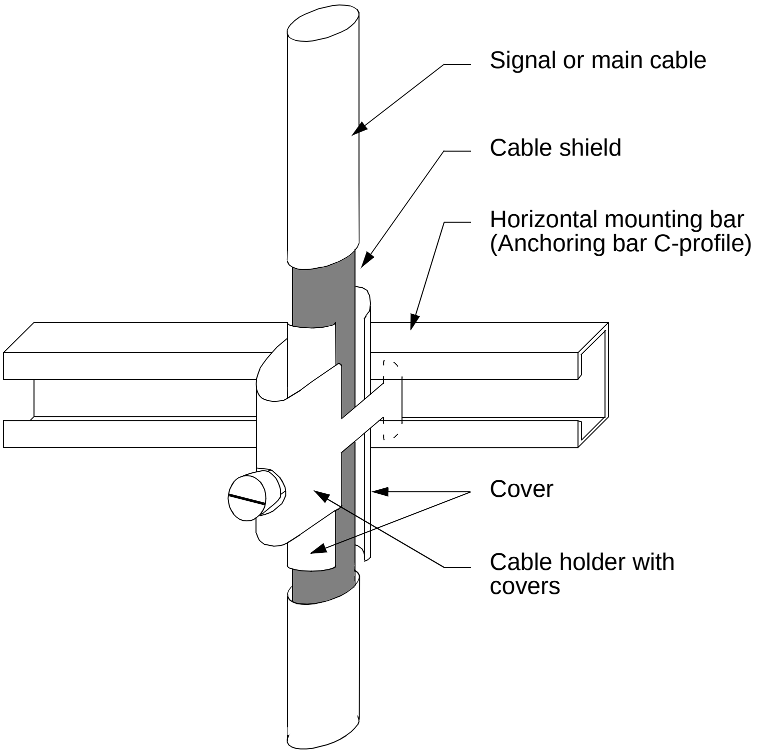


Figure 2-10. An other example of Attachment of the Cable Shield in a Conventional Cabinet

2.4.1 Connections of Shields

2.4.1.1 General

If possible the screens of the process cables must be run all the way up to the relevant connection unit as shown in Figure 2-11. The screen connection must be less than 5 cm long.

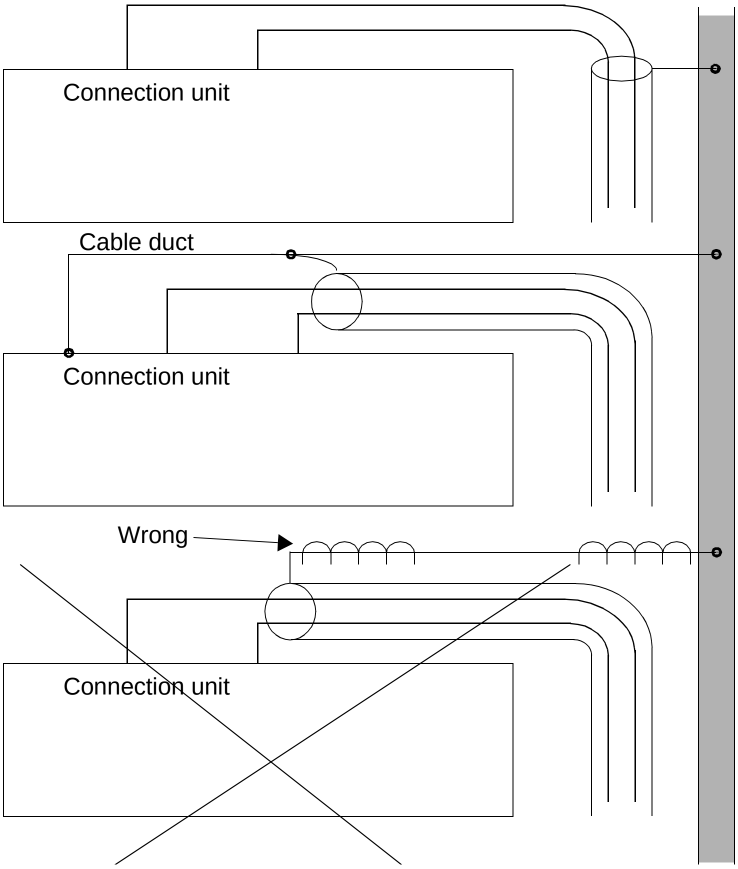


Figure 2-11. Connecting the Cable Shield in the Cabinet

If there is a large number of screened cables in the cabinet it is possible to terminate the screen where it enters the cabinet. See Figure 2-12.

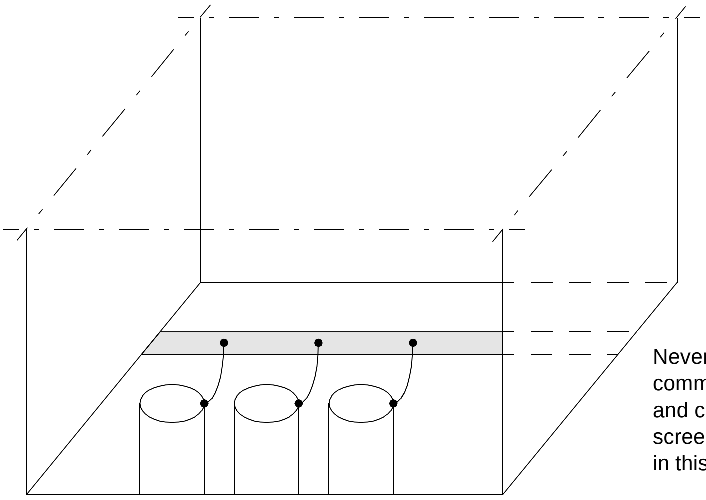


Figure 2-12. Connecting the Screen where there are Large Numbers of Cables Not permitted in the EU

The screens of the communication cables must be grounded through the connector on the connection unit or the communication module connector if grounding is applicable. Check with the actual communication documentation.

2.4.1.2 Adaption to EMC-Directive 89/336/EEC

In the EU and EFTA countries, there must be the connection of the cable shields to the cabinet fitted by 360° connection. The latter in the place where the cables penetrate the cabinet. It is normally made by a special sealing (See an example in Figure 2-9. The shields shall continue in the cabinet as described above. In other, than EU, countries the requirement on 360° shield connection can be omitted.

Shielded communication cables which are not directly grounded in the cabinet as well as shielded cables for analog signals with the signal circuit and shield grounded in the field are to be handled in a special way. The cable shield, in these cases, should be connected to ground via a capacitive decoupling device, located in the bottom of the cabinet. Check the relevance with the actual documentation.

2.4.1.3 Isolation of Shields

If the customer requires the vertical bar (in no “EEC application” only) to be isolated so that insulation measurements can be performed, the bar can be mounted on insulators and be connected to the chassis by means of 4 high-frequency and high-voltage capacitors (10 nF/1000 V). One disconnectable connection is to be made from the bar to the chassis. In normal service, this connection between chassis and cabinet must be properly closed.

NOTE

With this arrangement there is a risk of the connection between the bar and the chassis being forgotten, thus giving rise to an interference problem.

2.4.2 Telecommunications Rack (“Tele Rack”)

It is common practice to install connection units in “tele racks”.

NOTE

> In this case it is absolutely essential that the tele rack is extremely rigid and is bonded to the relevant cabinet at several points.

Connection units, mounting rails and cable channels must of course also be bonded to the tele rack in an improved manner. See Figure 2-13.

This installation practice is not generally allowed in the EU and EFTA. Each particular installation must be investigated and judged by a Competent Body according to article 10.2 of the EMC Directive.

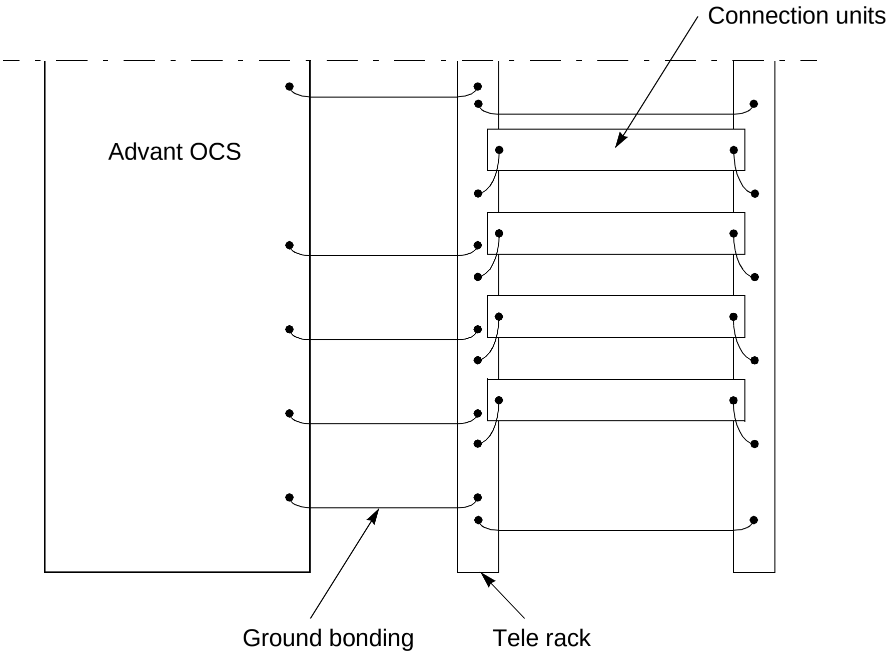


Figure 2-13. Using a Tele Rack

Mixing incoming and outgoing cabling to and from connection units must also be avoided in “nonstandard” assembly arrangements such as the one in Figure 2-14 since to do so would eliminate the interference suppression function of the connection unit.

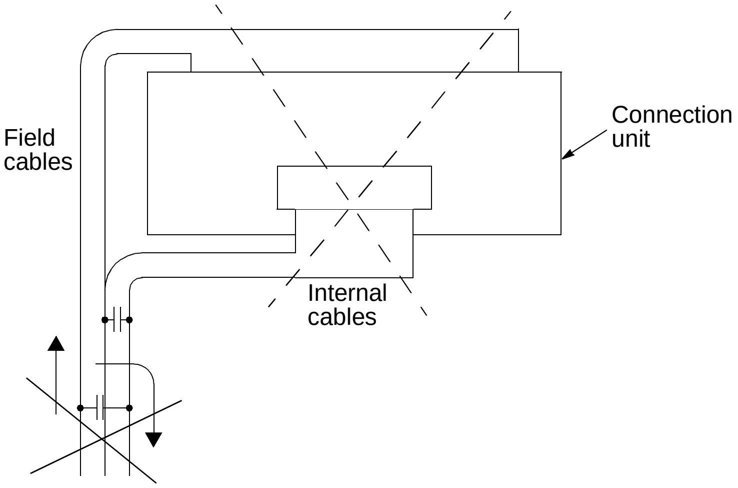


Figure 2-14. Never Mix Cabling to and from Connection Units in This Way

2.4.3 Cabinet Dimensions

The minimum dimensions for an apparatus cabinet are determined by the depth of the rack and the connection units and by the swing-out radius of the rack (in case of cabinets with hinged frame).

2.4.4 Degree of Protection

The degree of protection for the cabinet is determined by the environment at the field installation site. The power dissipation of the equipment must be taken into account in view of the heating effect in the cabinet. VSH 200 and RE cabinets are available with the following degrees of protection:

- IP21 ventilated
- IP54 sealed
- IP41 tropical version.

For further details see in the particular product documents.

2.4.5 Grounding of Cabinet Components

All cabinet components must be bonded together with extremely good and permanent ground connections. The connections should preferably be made with thread-cutting screws with cutting head. Where thread-cutting screws are not used on painted components, the paint must be scraped away under the head of the screw and the nut and surface must be smeared with conducting grease.

It is of the utmost importance that the (hinged) frame, the racks and the rear mounting plane for the connection units are effectively bonded together electrically (grounded) via the chassis (frame). The hinged frame must be connected to the cabinet frame at the top and the bottom with strips max 20 cm long (min. area 10 mm^2). The rear mounting plane must also be connected to the chassis at least 4 points.

In some cabinets, there is a horizontal grounding bar (5 x 30 mm copper for example) at the bottom for protective grounding, and a vertical grounding bar (3 x 12 mm copper for example) on the side where the external cabling comes in. The screen of the external cabling should be connected to the bar as described above. The vertical grounding bar should be grounded to the chassis at least 5 points and be bonded to the horizontal grounding bar via a 10 mm^2 yellow/green copper conductor (protective function).

2.4.6 Cabinet Lighting

Filament lamps must be used for lighting. **Fluorescent tubes must not be used**, since there is a great risk that the radiation from them will damage EPROM.

2.5 ESD Protection during maintenance

All maintenance in the cabinet is only allowed when the protective “ESD restrap”, fitted in the cabinet, is used.

2.6 Summary on Mounting of Units in Cabinets

2.6.1 Grounding of Units

In the same way as mounting rails, all units such as subracks, power supply units and terminal rails must be bonded to the frame (chassis) by means of approved mounting screws or short connecting wires, max. 5 cm long, on both sides of the unit.

Other units must be grounded in a suitable manner, possibly via max. 5 cm long connections to the chassis plate or to the copper grounding bar. In ABB cabinets, all these connections must be made with tapered self- tapping screws with teeth under the head. For non-ABB cabinets, see Section 2.1.2 Non-ABB Cabinets.

Incorrectly mounted units give very poor protection against high-frequency interference and electrostatic discharges (ESD).

2.6.2 Grounding of Connection Units

Connection units must be grounded via the mounting screws to the mounting rail. It is important that the mounting screws are not too long. Check that the screw head makes proper contact with the tinned surface of the ground plane of the circuit board. It is also of the utmost importance that the screws are tightened properly to give a reliable ground connection. If the mounting screws are not properly tightened, currents will be forced through to the I/O board and cause malfunctions or destroy components. See Figure 2-15.

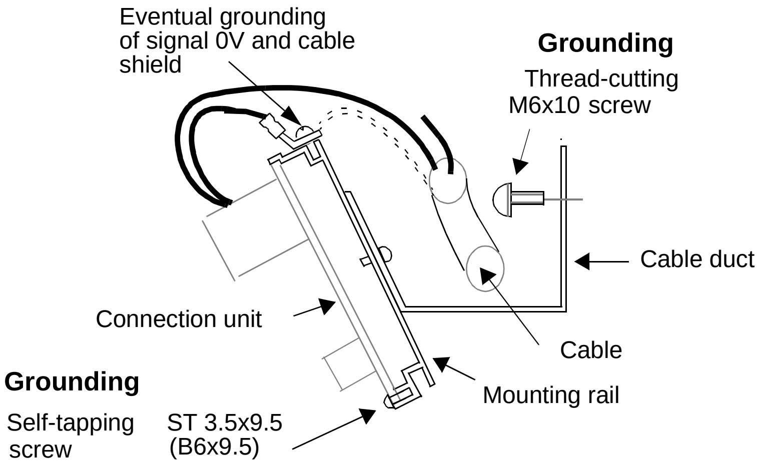


Figure 2-15. Grounding of Connection Units

2.6.3 Wall Sockets and their Protective Grounding

Certain products include a grounded wall socket to which the servicing aid or other peripherals like keyboard, printer, hardcopy printer etc. can be connected. This arrangement makes it possible to supply the peripherals from the same mains supply as the Advant OCS.
The requirement of a common supply does not apply if there is a d.c. isolation in the communication link, i.e. a modem for data transfer. A monitor must always be supplied from the electronics cabinet (MasterView). The output of the socket must be connected directly by an unbroken wire to the horizontal grounding rail of the cabinet (green/yellow wire).

NOTE

Where 2-phase supply without protective yellow/green ground wire (PE) is used, wall sockets must not be connected without a safety transformer; see Figure 2-16.

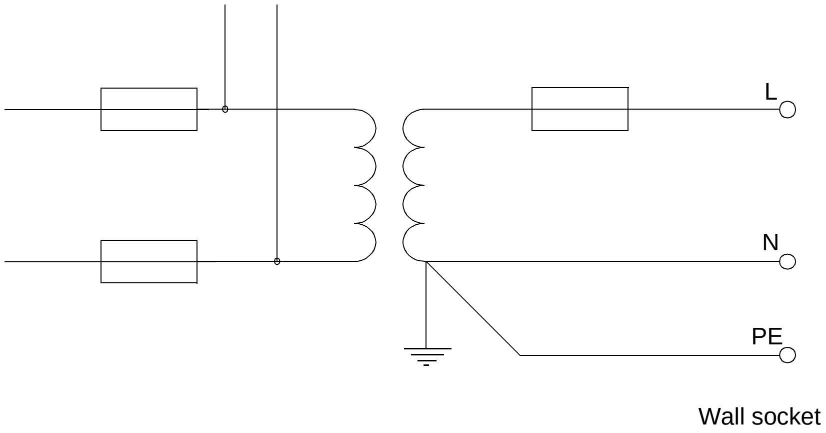


Figure 2-16. Connection Arrangement where only Two Phases without Protective Ground are Used

2.6.4 Placing of Units in Cabinets, Protection from Accidental Contact

Subracks with circuit boards are mounted close to the rear plane of a cabinet or in a hinged frame of the cabinet alternatively. The latter apply to the S100 I/O system which also include connection units for connecting the process signals. Connection units are always mounted in the back plane of the cabinet.

Figure 2-17. RE5XX Cabinet with I/O-Subrack with Expansion Arrangement for Connection Units and Modem for Communication

Because of standard cable length, connection units can be placed within a range of 17 S modules above and 30 S modules **below the level of the respective I/O boards in the rack.**

NOTE

Connection units for I/O and communication must be placed in such a way that separation of cables as shown in Figure 2-19 is possible.

Figure 2-17 illustrates the appearance of a typical controller with I/O in a RE5xx double cabinet.

If a connection unit has the accidental contact protection shown in Figure 2-18, this must be fitted in such a way that it has a ground connection to the mounting rail. Cable holders on the internal cable must be screwed to the accidental contact protection with two self-tapping screws. The protection and the cable holder are also used on certain communication units to connect the screen.

NOTE

In other respects this is an electrical safety device.

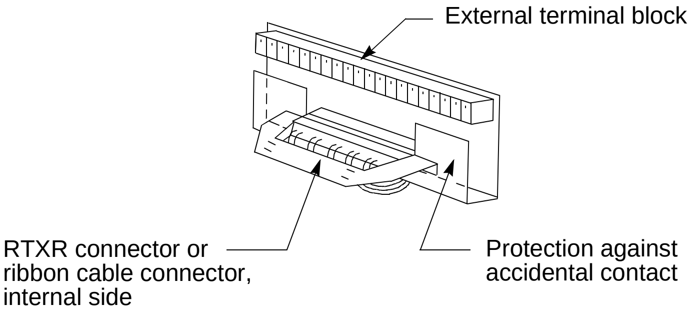

External terminal block
RTXR connector or ribbon cable connector, internal side
Protection against accidental contact

Figure 2-18. Connection Unit with Protection against Accidental Contact

2.6.5 Positioning of Circuit Boards in Subracks

The positioning of circuit boards is described in the particular product documentation.

Each I/O rack has space for 20 I/O boards. When distributing different types of boards, the heat dissipation must be taken into account. There are no special rules for the positioning of circuit boards in I/O racks.

2.6.6 Item and Terminal References

Every unit (circuit board, subrack, connection unit etc.) is given its own item reference to facilitate documentation, assembly, commissioning and troubleshooting.

A position-oriented item designation system is used.

2.6.7 Cable Routing in Cabinets

Internal wiring such as ribbon cables for bus extension, ribbon cables to modems and connection units, and single wires (SKUB) to connection units are all sensitive to interference. These cables must be kept well separated from external cables. Internal communication cables, communication ribbon cables, internal local cables and internal power supply cables must always be kept separate in their own groups, well apart from each other. Cabling from additional units such as relay racks must be separated from internal cabling in individual groups. **No exceptions!** See Figure 2-19. Screened ribbon cable is used for some connections. Both ends of the screen must be connected with a wire not more than 5 cm long to the rack or to the nearest point on the chassis, if the cable is to be grounded in the cabinet. Make sure that all cables are provided with proper strain relief with straps, for example. Protect the cables from sharp edges.

NOTE

No external incoming cable to the cabinet may be connected directly to a S100 I/O circuit board without passing through an interference barrier (=connection unit). **No exceptions.**

When installing the cables between subracks and connection units, it is important to ensure that the door can be opened and closed without the cables being stretched, crushed or tangled in each other.

The protective ground wire of incoming supply must be connected directly to the horizontal grounding bar or to the connection point for the protective ground at the bottom of the cabinet.

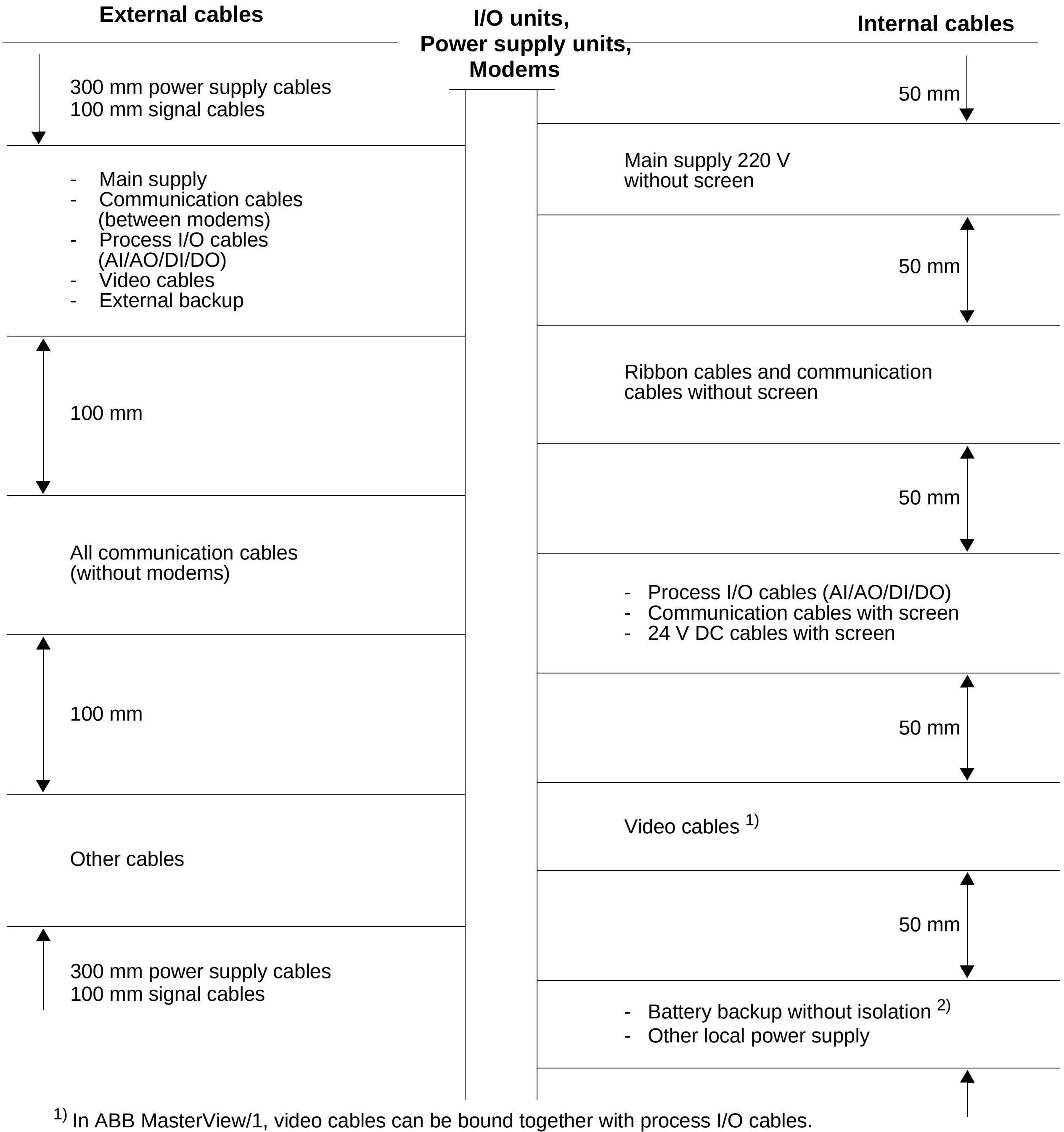
Incoming signal cabling must be anchored to support-bars along the side of the cabinet. Reflect the requirement of segregation of externals and internal cables.

Figure 2-11 and Figure 2-12 show how to connect the screen.

Connections in Figure 2-11 are second connections of the screen in the radio proof cabinets. Connection in Figure 2-12 is not applicable in a radio proof cabinet.

2.6.8 Cable Routing Outside the Cabinet

There are only a few restrictions on routing of field cables belonging to Advant OCS. Communication cables for communication without modems must be at least 10 cm away from all other cables, including Advant OCS cables. Advant OCS cables must be kept well away from other non-Advant OCS cables, at least 10 cm and from power supply cables >250 V, at least 30 cm. See Figure 2-19.


External cables
I/O units, Power supply units, Modems
Internal cables
300 mm power supply cables
100 mm signal cables
- Main supply
- Communication cables (between modems)
- Process I/O cables (AI/AO/DI/DO)
- Video cables
- External backup
100 mm
All communication cables (without modems)
100 mm
Other cables
300 mm power supply cables
100 mm signal cables
50 mm
Main supply 220 V without screen
50 mm
Ribbon cables and communication cables without screen
50 mm
- Process I/O cables (AI/AO/DI/DO)
- Communication cables with screen
- 24 V DC cables with screen
50 mm
Video cables 1)
50 mm
- Battery backup without isolation 2)
- Other local power supply

[1] In ABB MasterView/1, video cables can be bound together with process I/O cables.

[2] When the battery backup is to be supplied from a central battery, the connection cable is a “field cable” and is to be separated from internal cables in the cabinet. This connection is only permitted when a protection barrier is used in the cabinet.

Figure 2-19. Cable Routing Outside and Inside the Cabinet

2.6.9 Bus Extension

Where extra I/O subracks are included, the parallel data bus must be connected across from the central subrack to the I/O subracks via bus extension boards. The subracks are connected together with a special ribbon cable which is routed along the right-hand side of the subrack.

2.6.10 Connection Units

Connections between S100 I/O boards and the associated connection units are made with prefabricated ribbon or multi-core cables. The cables have a standard length of 3 meters and must be routed as shown in Figure 2-8.

2.6.11 Grounding of Units

In connection to enlargement of the system the following may be essential.

On all units that have a 0 V pin intended for grounding in the X2 connector, the pin must be connected to the rack by a short connection (< 5 cm) through the process side of the connector. See Figure 2-20. This applies to power supply units, microprocessor boards and memory boards in ABB MasterPiece 200, MasterView 800.

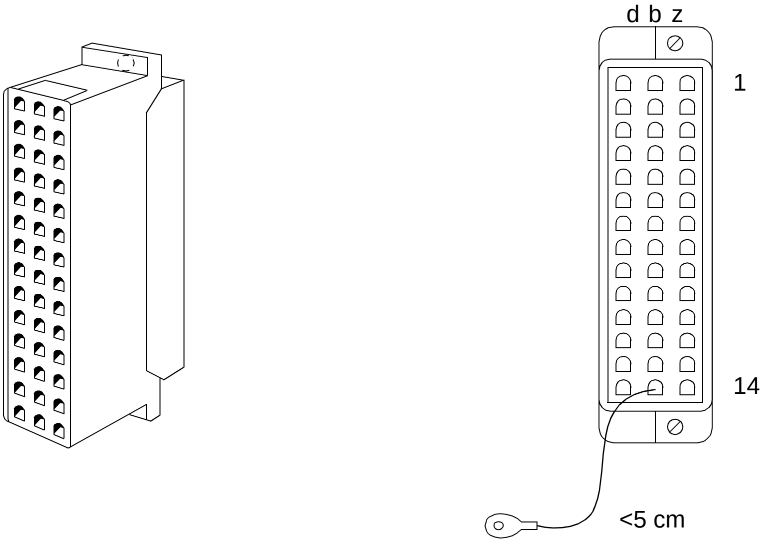


Figure 2-20. Grounding of 0 V through the X2 Connector

2.7 Radio-proof Cabinets

To limit radiated emission and to ensure radiated immunity to field strength of 10 V/m, it is essential to use radio proof cabinets. Such cabinets also provide protection against outgoing radio emissions and in this respect satisfy the strictest legal requirements in European Community and the USA in accordance with EN 50081-2 and FCC 15 J.

There is a radio-proof version of VSH 200 and RE5xx.

Protection against line conducted radio emissions is obtained by means of a special filter placed in the bottom of the cabinet on the incoming supply. See Figure 2-21.

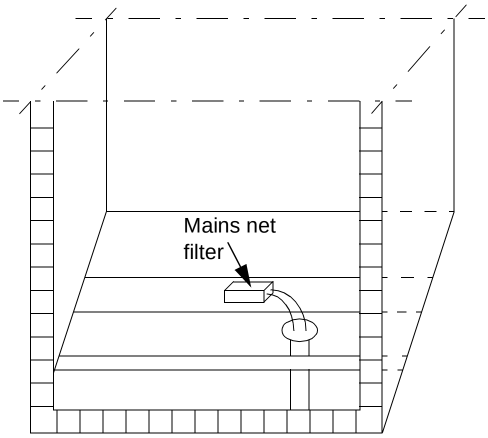


Figure 2-21. Radio-Proof Cabinet

2.8 Erection of the Cabinet

The apparatus cabinet must be erected on a stable surface and must be bolted or welded without printed circuit boards in the cabinet into position.

The free space in front of the cabinet should be equal to the width of the door plus aisle width, i.e. min. 1.2 m. Above the cabinet, there must be free space of at least 150 mm to the ceiling to ensure ventilation.

When installing the cabinet against the wall, the distance between the cabinet and the wall must be at least 40 mm, otherwise the maximum power dissipation will have to be reduced.

Advant OCS mounted in a VSH 200 and RE5xx cabinet, can be set up side by side with other cabinet types, but the side plates must not be removed. Where several electronics cabinets of the same type, related to one controller with S100 I/O, are to be set up in the same row, however, it is permissible to remove the side plates between the cabinets.

2.9 Checking the Contact Resistance to the Frame

In connection to enlargement of the system the following may be essential.

After the units have been installed in the cabinet, the contact resistance between all units and ground (frame) must be checked with the system switched off and with ribbon cables disconnected. The contact resistance between the end panel of the rack and the zero plane of the connection units must also be measured (max. 0.1 ohm).

The measurement should be done with a DVM with the appropriate resolution. The absolute accuracy of the instrument used is unimportant. Before measuring, the instrument must be calibrated by measuring the resistance of the short-circuited measuring leads. Note this value and always subtract it from the reading obtained from the prescribed measurements.

2.10 Advant OCS Applications According to EMC Directive 89/336/EEC

With regards to EMC Directive 89/336/EEC Advant OCS equipments will be specified, produced and delivered according to the following:

Most Advant OCS products can be received in version a) or b).

Version a):	Verified according to article 10.1 or article 10.2 of the EMC Directive by application of EN 50081-2, EN 50082-2 or by Technical Construction File approved by a Competent Body.
Version b):	Verified according to the international immunity standards.

Characteristics for version a) of controller products are:

- Equipment to be located in metallic or radio proof cabinet (depending of product).
- Cable shields which are to be directly grounded in the cabinet must be additionally grounded close to their entrance in the cabinet.
- Shielded cables which are not directly grounded in the cabinet are to be connected via a capacitive decoupling device, located in the bottom of the cabinet.
- Power supply is to be equipped with special power supply filters located directly to the power supply entrance in the cabinet.
- Grounding wires are to be as short as possible.
- Spares in the cables are to be grounded.
- Hinged frame (where applicable) is to be connected by 2 striplines to the chassis instead of wires.

2.11 Immunity Against Electromagnetic Fields

2.11.1 Background

It has been shown that the immunity features with regards to the electromagnetic fields can be misunderstood. Here follows an explanation:

The accepted protection against electromagnetic fields can be achieved by shielding or by using filters. The Advant OCS units use both of them. Degradation of the shield or/and degradation of the filters degraded the interference protection partly or completely. All interference type-tests with regards to the electromagnetic fields have been carried out on Advant OCS products in a configuration with an entire metallic cabinet in the anechoic chamber (reflection-free chamber) according to IEC norm 1000-4-3, ENV 50204 and 1000-4-6 in frequency range 150 kHz - 1 GHz.

2.11.2 Application of the Test Result

Quote from IEC 1000-4-3 (version 2) follows:
“The above mentioned test methods are defined for measuring the effect that electromagnetic radiation has on the equipment concerned. The simulation and measurement of electromagnetic radiation is not adequately exact for quantitative determination of effects. The test methods defined are structured for the primary objective of establishing adequate repeatability of results at various test facilities for qualitative analysis of effects.

The question regarding what field strengths E may be expected from commercial portable transceivers frequently arises. The basic of the question centers around the fact that these communication devices are a dominant radiating interference source affecting electronics.

The portable transmitter can be treated as a dipole with the case of the transceiver being the second limb. The field strength E is defined by the formula:

$$E = \frac{K\sqrt{P}}{r}$$

An analysis of measurements conducted by the ERA (Electrical Research Association) and the Research Department of Electricité de France (EDF) on walkie-talkies from six different manufacturers with power ratings ranging from 0,5 W to 12 W at VHF and UHF frequencies reveals a spread of coefficients ranging from k = 0,45 to k = 3,35 depending mainly on the length of the antenna with respect to the wavelength. Walkie-talkie antennas typically have a length compared to $\lambda/4$ corresponding to k = 3,0.

Thus the statistical average can be expressed as

$$E = \frac{3,0}{r}\sqrt{P}$$

where P = manufacturers advertised rating of the transceiver in watts

r = distance (greater than $\lambda/2\pi$)

Since the experiments were conducted in a shielded enclosure it can be assumed that a sufficiently adequate ground plane existed. In actual practice the portable transceiver is held and keyed by operating personnel. As such additional losses can be expected. In the light of above the statistical average assumes a more realistic guidelines for approximating field strengths.

3V/m	Low power portable transceivers (typically less than 1W rating are in use but with restrictions on use in close proximity to the equipment.
10V/m	Portable transceivers (2W) are in use relatively close to the equipment but not less than 1 meter.
	High power broadcast transmitters are in close proximity to the equipment and ISM equipment may be located close by.

The levels described above are typical values which are rarely exceeded in the locations describes. In such cases it may be preferable to shield the room, or building and filter the signal and power cables to the equipment, rather than specify all equipments to be immune to such levels.”

Finally it must be emphasized that all cables act as the antenna, especially when their length is a multiple of a wave length divided by 4(λ/4). These cables may bring the electric and magnetic field into the cabinet and in this way interfere with electronics concerned.

The earlier presented conclusions in IEC 801-3/1 are to be modified with regards to the experiences achieved by analysis conducted by several research associations.

2.11.3 Application to the Advant OCS

With the experiences, which we have with the Advant OCS, the immunity against electromagnetic fields can generally be guaranteed with the cabinet containing metallic doors only.

However, Advant OCS products can also be used for a particular radio frequency at a particular site with a glass door if the required immunity is verified at site.

Attention:

This latter statement is never valid for the cabinet(s) certified according to EMC Directive 89/336/EEC.

2.11.4 Conclusion

In the cabinet with glass door the achieved immunity is depending on

- The contents of the cabinet
- The type of the cabinet
- The cable types, their location and grounding
- The reflections in the cabinet and at site (surrounding environment) and is completely different from one cabinet to another.

Chapter 3 Checklists

3.1 Grounding Philosophy, Grounding Line System

Table 3-1. Grounding Philosophy, Grounding Line System

Item	Function	Action
Grounding philosophy	Ground system	Grounding only to power ground line network. Only one grounding system. No exceptions.
Ground line system	Design	The ground line system of the installation must be carefully installed and must incorporate the switchgear.

3.2 Process Cabling, Screening, Grounding, Max. Length

Table 3-2. Process Cabling, Screening, Grounding, Max. Length

Item	Function	Action
Cables	Prescribed type	Communication cables Pulse transducer cables Screened for AI ≥ 12 bit and for LL AI (RTD, Pt, thermocouple) Same signals in same cable (LL), (DC), (AC), (Com), (PS). Signal wire and return wire in same cable
Screening: Single screen	Grounding: AI, AO, DI, DO, KM-1	Same position as signal circuit
	Grounding: Communications pulse transducers	At both ends
Screening: Double screen	Grounding:	
	Outer screen	Both ends
	Inner screen	As signal circuits
Cable without screen	Grounding	All signal circuits grounded at the same end
AC digital inputs 115 V and 230 V	Max. cable length	115 V 230m 230 V 115m
Screen connections in radio proof cabinet	Connection	Cable screens which are grounded in the cabinet must be immediately grounded directly or via capacitor when they enter the cabinet.
Shielded cables not grounded in the radio proof cabinet	Location	Double screen or capacitive decoupling is to be used (see Section 3.5 Subracks, Connection Unit, Circuit Boards and Section 3.9 Communications, Communication Cables)

3.3 Supply

Table 3-3. Supply

Item	Function	Action
AC MAINS	Connection in cabinet	Phase Return Protective ground (if distributed) **Note:** There must be no breaks in the protective ground before the connection to the copper bar or to the connection point for protective ground.
	Fuse	In phase (phases)
	Wall socket in cabinet	Grounded If protective ground not distributed, via safety transformer.
	Connection of mains:	No unsuppressed load on same finale circuit from distribution box.
	- Special transformer for electronics - Internal distribution	When using interference-sensitive power supply units not manufactured by ABB: - To electronics through transformer (e.g. in unstabilized power supply) - Other: Incoming power supply (110, 230 V) must be separated from other cables by 5 cm or more.
DC (floating battery)	Grounding, supply	Negative pole to copper bar of cabinet directly at entry to cabinet. Supply via filter
DC (grounded battery)	Connection	Via DC/DC converter
Rack supply	Max. power output	< 90% of stabilizer capacity
Energy reserve		Min. 15 ms Conditions: - max. rate of change 0.4 V/ms for unstabilized supply - min. 19 V including ripple for unstabilized supply
Field supply from supply for electronics (24 V)	Protection	Only via barrier. Negative pole grounded directly at exit from cabinet and hv/ hf capacitor between + and -.
Advant Station 500, UPS, Periphery equipment (Monitor, Keyboard, Hard copy ....)	Protection	Connection to lighting network only (overvoltage class II)

3.4 Lightning Protection

Table 3-4. Lightning Protection

Item	Function	Action
Lightning protection	Compulsory for all circuits in:	Overhead lines Cables above ground Cables that leave the general ground line network

3.5 Subracks, Connection Unit, Circuit Boards

Table 3-5. Racks, Connection Unit, Circuit Boards

Item	Function	Action
Mounting rail (also Tesselator and MasterView)(1)	Ground connection to copper bar in cabinet via mounting screws.	R < 0,1 ΩΩ, measured with equipment switched off and ribbon cables disconnected.
Rack	Ground connection to copper bar in cabinet via mounting screws.	R < 0,1 ΩΩ, measured with equipment switched off and ribbon cables disconnected.
Connection unit (also Tesselator and MasterView)(1)	Ground connection to mounting rail via mounting screws.	All screws fully tightened
Mounting rail mounted outside or in nonstandard cabinet(2)	Electrical connection with cabinet from both ends of mounting rail. Internal or external cabling to connection must be kept apart.	R < 0,1 ΩΩ, A = 10 mm^2 in tele rack 2,5 mm^2 in the cabinet Spacing > 100 mm
Circuit board with 0 V at X2	Grounding of 0 V	Connection to chassis from X2 0V < 50 mm
Connection	Quality	Only correctly made, screwed or clamped connections are approved. **NOTE:** Inspected and approved tools must be used.
Circuit boards	Variant reference	Lowest approved variants as per “Techlines” list
Analog input circuit boards(1)	Full accuracy in the frequency range	DSAI 130 + DSTA 130(131) The other analog units can have for some frequencies in frequency range 0,15 MHz to 60 MHz error >0,2%.

(1) Applicable only to the system using connection units with interference barriers.

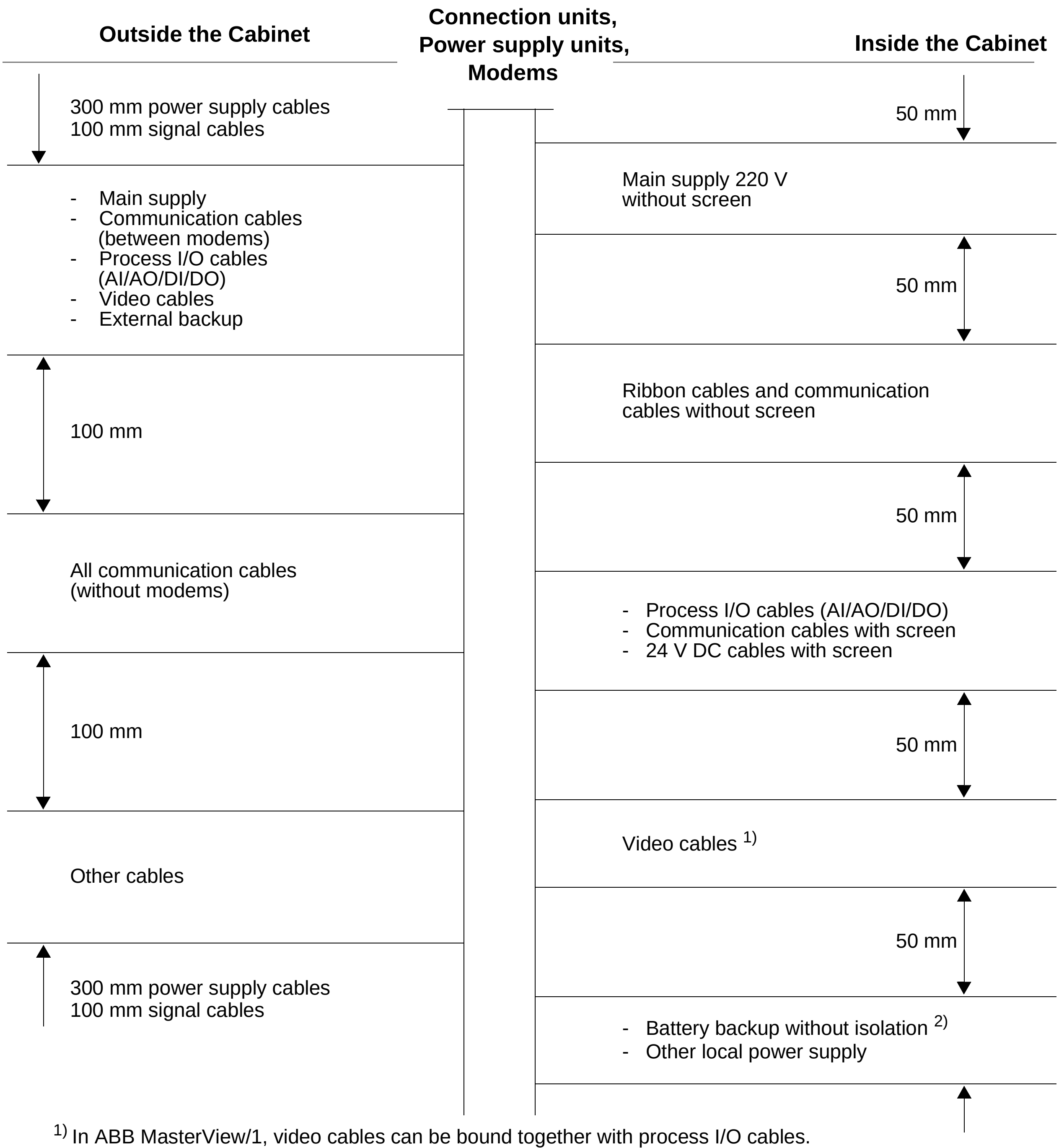
(2) This configuration does not meet the limits for emission and therefore is not generally allowed within the EEC area (EU,EFTA)

3.6 Cabinets, Internal Cables

Table 3-6. Cabinets, Internal Cables

Items	Function	Action
Metallic door with glass window	Shielding	Interference immunity for the particular frequency which will be used, must be verified by a relevant walkie-talkie. Not allowed within EEC.
Row of cabinet	Electrical connection	Through horizontal copper rail (or short 35 mm^2 copper conductors)
Hinged frame	Electrical connection to chassis (copper bar)	2 cables, top and bottom of hinged frame L < 250 mm, A = 10 mm^2
Cabinet parts (plates)	All parts electrically connected to each other and to the copper bar	R < 0,1 ΩΩ
	Divided cabinets	Connection with special screws and nut bars
Copper bar, vertical for external screen connection	Electrical connection to chassis	More than 4 points along entire length R < 0,1 ΩΩ
Copper bar, horizontal	Electrical connection to chassis at both ends	R < 0,1 ΩΩ
Grounding in cabinet	Design	Only one grounding system for ABB Master equipment **NO EXCEPTIONS**
Lighting	Design	Only by filament lamp
Temperature in cabinet	Max. permitted temperature for continued operation in cabinet is 55 °C	Measured just above the racks
Radio emission	Emission	Where EN or FCC requirements must be met, only radio-proof cabinets
Screened cable-ribbon cable	Design	Communication, pulse transducers and analog circuits for LL (RTD Pt, thermocouples) must be screened up to the circuit boards.
Internal cables (Figure 3-1)(1)	Routing	Incoming power supply cabling, ribbon cables without screen for communication and other local cables must be kept more than 50 mm away from all other cabling.
	Connection of screen, incoming cables	Up to level of connection unit, screen connection max. 50 mm long.
	Screen ribbon cable	If the screen is intended to be grounded in the cabinet, it is connected to the chassis at both ends.
	Battery backup 24 V	Cables from DSSB 120 must be kept more than 50 mm away from all other cabling to a backup unit without isolation transformer (DSSB 140).

(1) Applicable only to the systems using connection units with interference barriers.


Outside the Cabinet
Connection units, Power supply units, Modems
Inside the Cabinet
300 mm power supply cables
100 mm signal cables
50 mm
Main supply 220 V without screen
- Main supply
- Communication cables (between modems)
- Process I/O cables (AI/AO/DI/DO)
- Video cables
- External backup
50 mm
100 mm
Ribbon cables and communication cables without screen
50 mm
All communication cables (without modems)
- Process I/O cables (AI/AO/DI/DO)
- Communication cables with screen
- 24 V DC cables with screen
100 mm
50 mm
Video cables 1)
Other cables
50 mm
300 mm power supply cables
100 mm signal cables
- Battery backup without isolation 2)
- Other local power supply

[1] In ABB MasterView/1, video cables can be bound together with process I/O cables.

[2] When the battery backup is to be supplied from a central battery, the connection cable is a “field cable” and is to be separated from internal cables in the cabinet. This connection is only permitted when a protection barrier is used in the cabinet.

Figure 3-1. Routing of Cables

3.7 Service Aids

Table 3-7. Service Aids

Item	Function	Action
MasterAid 213, 214, 215 (1)	Connection in cabinet	Supply taken from the cabinet, not from a separate wall socket
MasterAid 213, 214, 215 (1) in systems with battery supply only		Advant Station 100 Series ES must be supplied with power through a DC/AC converter from Advant OCS equipment if 230 V is not available in the cabinet.

(1) There are no restrictions on the main power supply of the Advant Station 100 Series ES, for example no requirement of earting and same supply, etc. The target system and the engineering station are galvanically isolated from each other by communication interface.

3.8 MasterView, Peripheral Units

Table 3-8. MasterView, Peripheral Units

Item	Function	Action
Power supply of peripheral units	Design	Only from MasterView cabinet. A DC/AC converter must be used if 230 V is not present in the cabinet.

3.9 Communications, Communication Cables

Table 3-9. Communications, Communication Cables

Item	Function	Action
Communication cables with screen (not coaxial cables)	Electrical connection to chassis	≤ 50 mm
	Max. permitted length	Max. specified length must not be exceeded
Coaxial communication cables	Electrical connection to chassis	Not to be directly grounded or grounded at one point only.
	Max. length	Max. specified length must not be exceeded. In radio proof cabinets a special unit (with HF capacitor) is to be used
Communication without modem	Routing of cables	More than 10 cm away from other cables
MasterBus 300 (Ethernet)	Cable length	Multiple of 23.4 m max. 500 m
	Joints	At odd multiple of 23.4 m (1, 3, 5 ....)
	Outdoor installation	Teflon cable in conduit which is grounded at both ends. An additional ground line > 35 mm^2 routed in parallel with the conduit and grounded at both ends.
	Routing	30 cm away from other cables or on separate cable rack for outdoor installation: underground in steel pipes
	Transceiver	Positioned at cable marking. Insulated from the ground plane > 10 cm Not covered with other cables Separated from other cables > 10 cm
	Drop cable	All screens must be connected together at both ends.
Thin wire Ethernet among Advant Stations	Cable location	Separated from other cables > 10 cm
	Configuration	**Only in the same room**, connected to the same power supply source.

3.10 Maintenance

Table 3-10. Protection against ESD

Item	Function	Action
Maintenance in the cabinet	ESD protection against latent faults	The restrap, fitted in the cabinet is to be used

3.11 Miscellaneous

Table 3-11. Miscellaneous

Item	Function	Action
Relays and contactors in cabinets	Suppression	Cabling to non-suppressed inductive loads in ABB Master cabinets must be kept more than 10 cm away from internal cables.
Thermo-couples	Supply connection	Power supply for compensation of cold junction on DSTA 155 is taken from the cabinet.
	Position of “CJC” (compensation unit for cold junction DSTA 155)	DSTA 155 must be placed as close to the object as possible. Located in the cabinet only if original (old) cabling is to be used.
Analog inputs / outputs	Type	Correct type: For grounded transmitters / receivers they must be differential or isolated.
Replacement of memory boards	Equipment switched off	Both main supply and back-up supply must be switched off (isolated).

Chapter 4 Enclosures

4.1 Example for the Choice of Cables

Table 4-1. Example of Cables (EXXX Cables: Only One Connection in a Terminal)

Transducer	Cable type	Max. voltage	Features
Pt	FKAR-PG	150/250 V	Pairtwisted, common single screen
Thermocouple	Screened compensation cable from transducer to DSTA 155		
	FKAR - PG	150/250 V	Pairtwisted, common single screen
Pulse LF (<10Khz)	FKAR - PG	150/250 V	
Pulse HF (>10KHZ)	FLAK	60 V	HF, pairtwisted, common single screen
AI / AO (LF) ≥ 12 bits	FKAR - PG	150/250 V	Pairtwisted, common single screen
AI / AO (LF) ≤ 12 bits	EKKX	60 V	Pairtwisted without screen
DI / DO	EKKX FKKR	60 V 350/500 V	Pairtwisted without screen
MasterBus 300	Ethernet coax		
	In wet environment with teflon		
MasterFieldbus LDB	RG 59 RG 11		30 dB/km 15 dB/km
	In wet environment PUR RG		
MasterFieldbus SDB	FLFR - A 3*2*0.34		
Severely noisy environment (PL4)	FKARPIG	150/250 V	Double screen. Pairtwisted, pairscreened
Advant Fieldbus AF 100	RG59		30 dB/1000 m

Chapter 5 Configuration “AccuRay System” and Advant OCS

The AccuRay system is designed for protected installations. Therefore all cables included in the system must be installed in conduits. The internal shielding of AccuRay cables provides protection against low frequency interference only.

Protection against conducted high frequency interference and electromagnetic and magnetic fields is achieved by the use of ferromagnetic conduits.

The combination of shielding and cabinets meets the requirement for interference-free functionality for industrial equipment. For uniformity of the configuration conduits will be used for incoming power to the Advant OCS and for communication between the AccuRay system and Advant OCS. Otherwise the Advant OCS is to be treated according to the standard installation rules.

Field wiring to the Advant OCS may be installed without conduits.

For more details see Figure 5-1 - Figure 5-6.

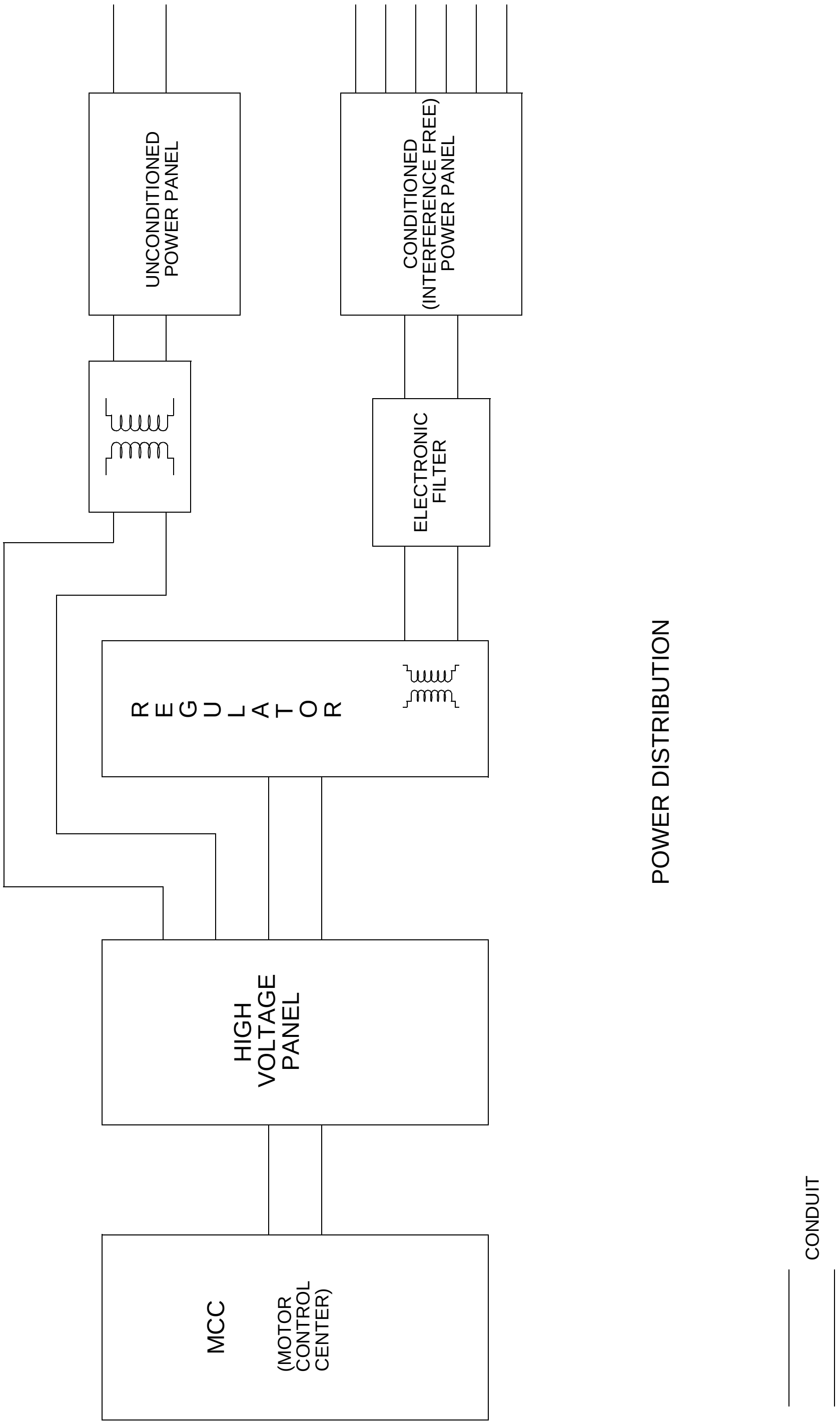


Figure 5-1. Power Distribution

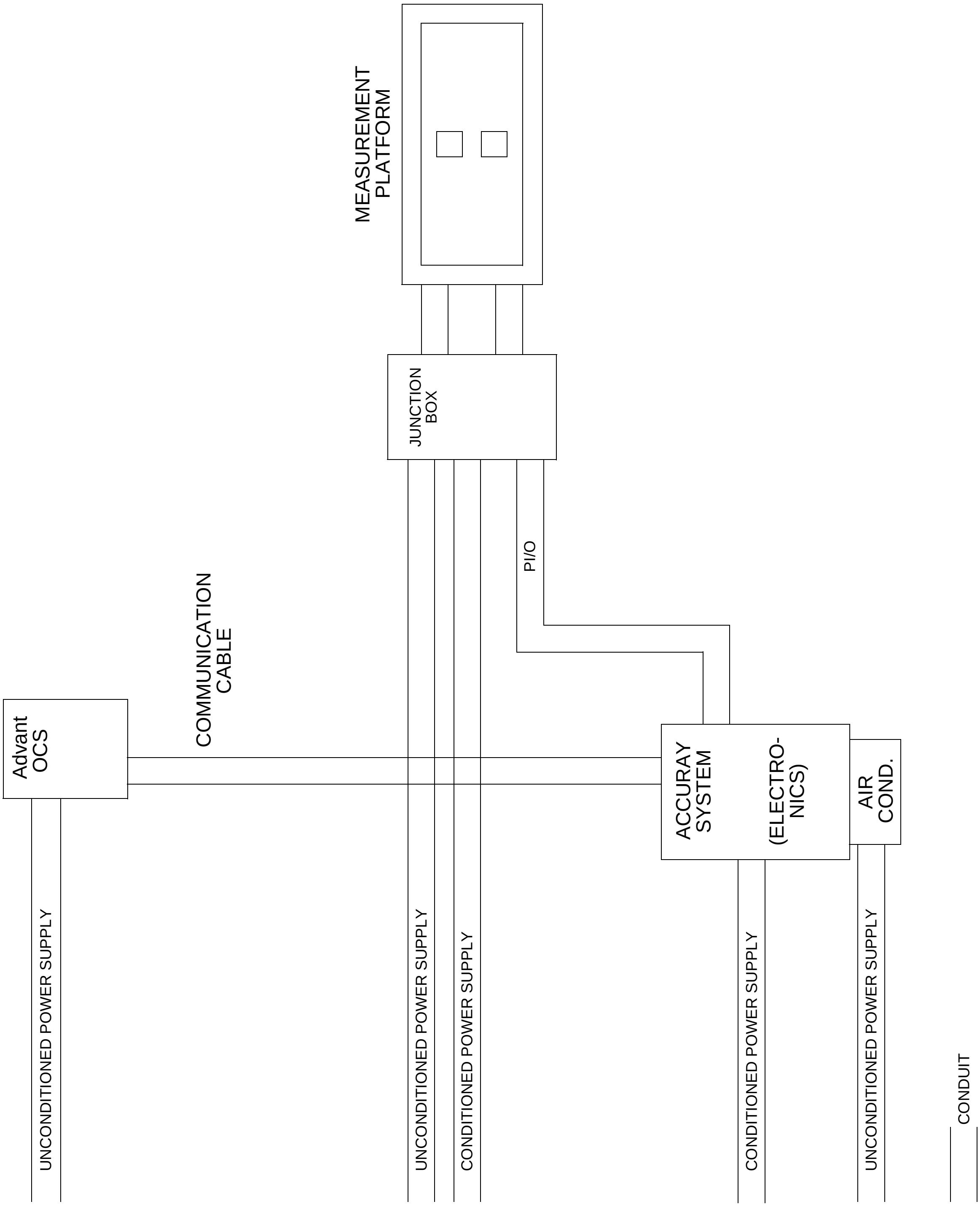


Figure 5-2. Power Distribution (Cont.)

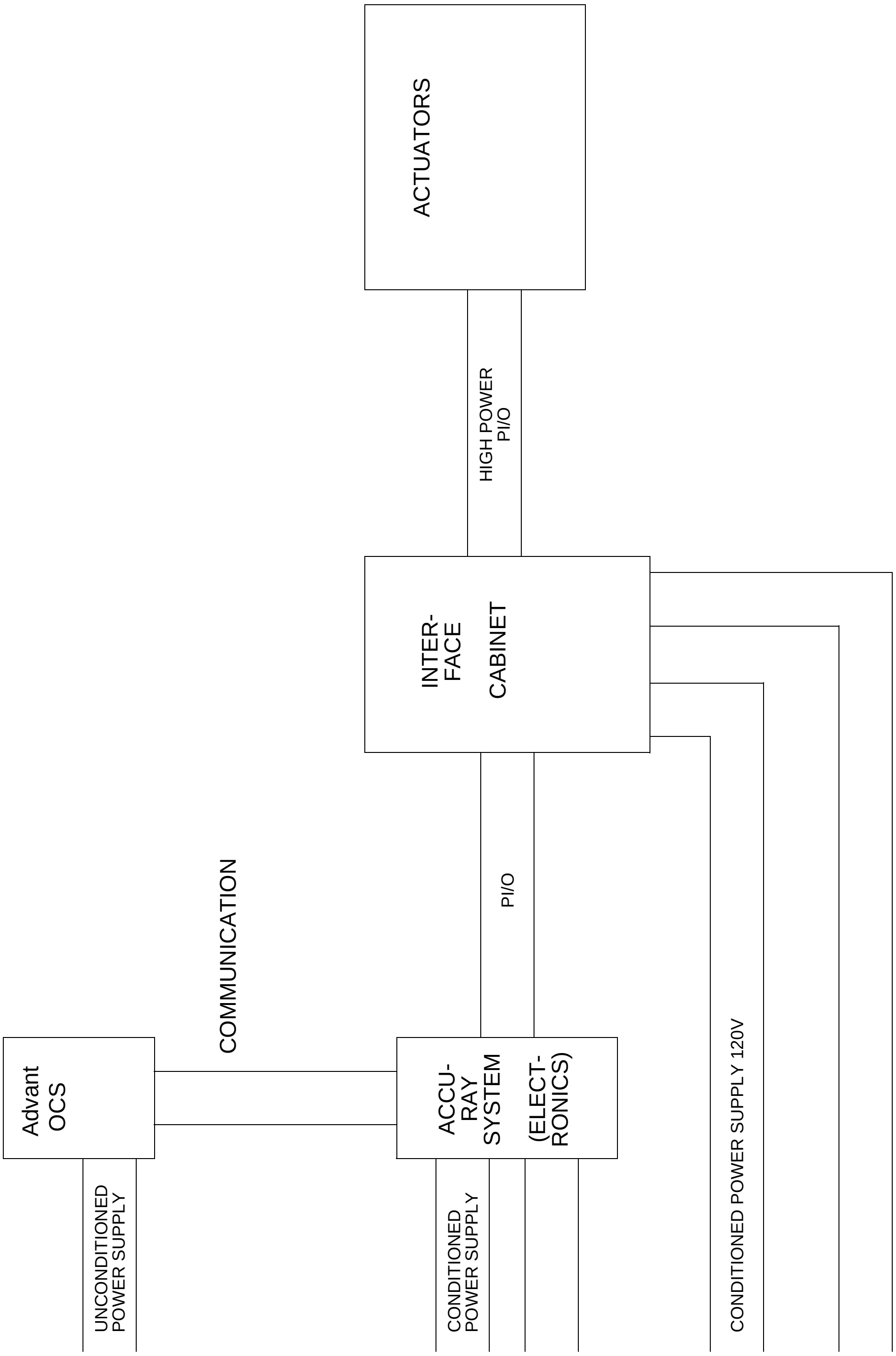
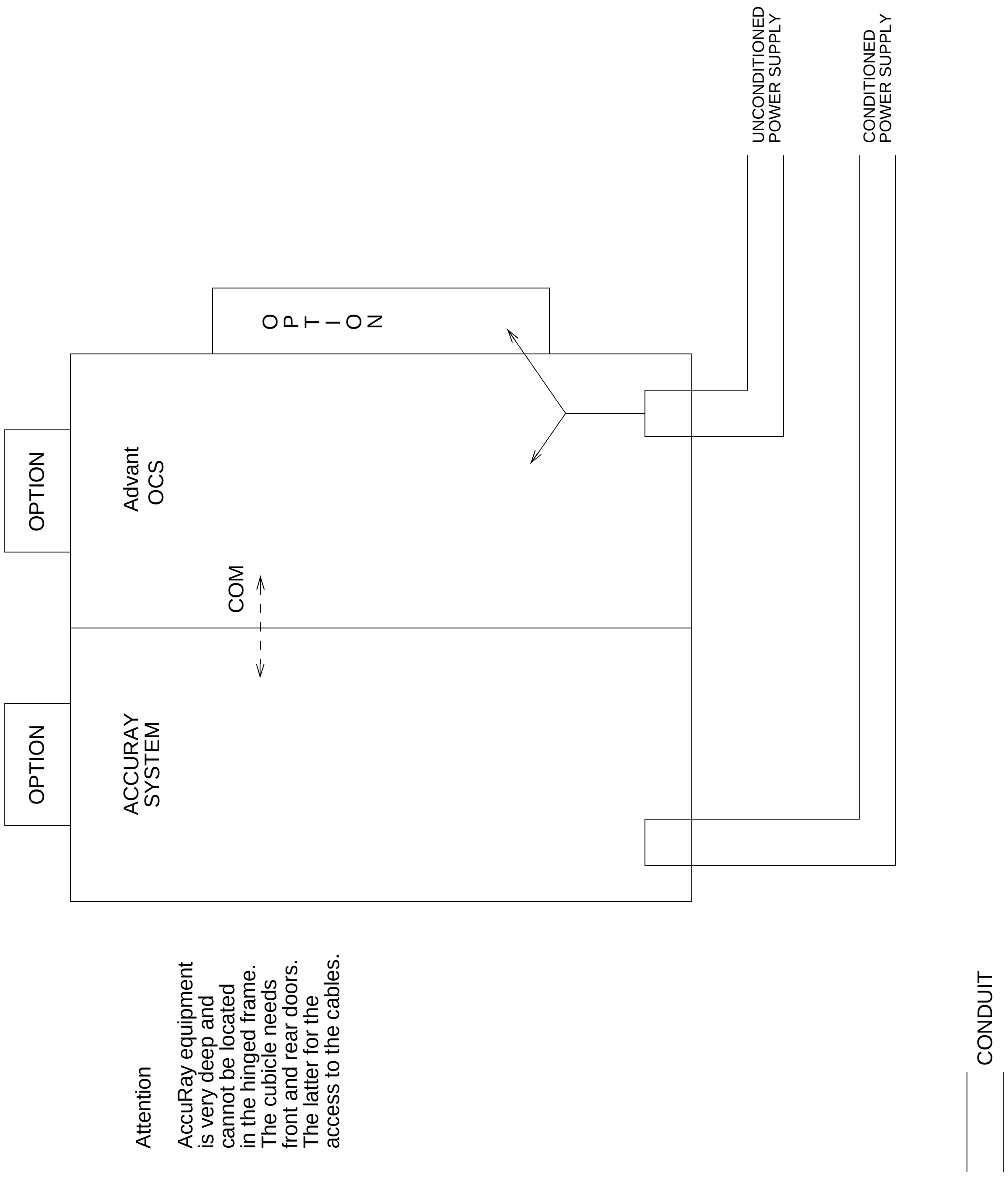


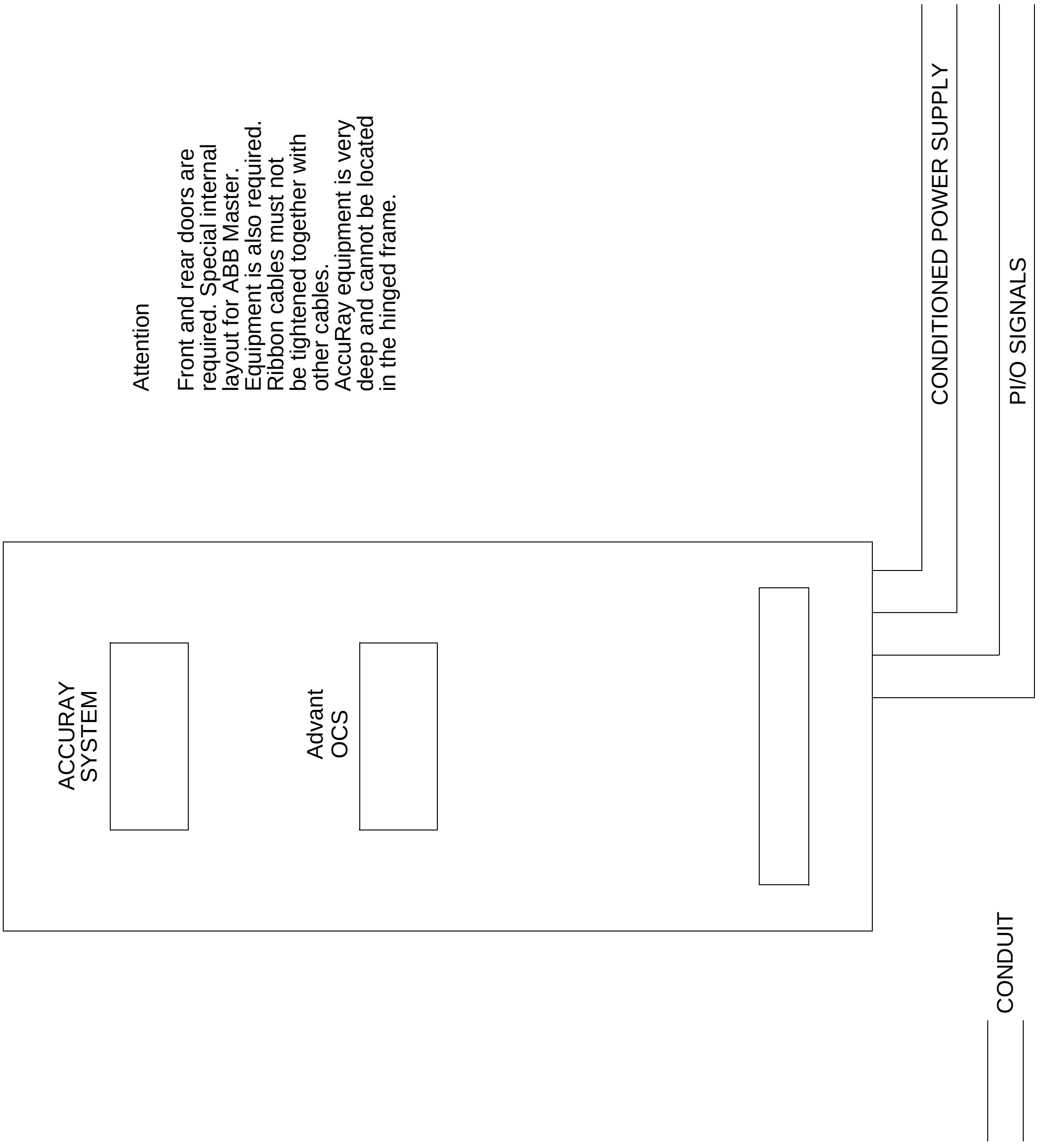
Figure 5-3. Power Distribution (Cont.)



Attention

AccuRay equipment is very deep and cannot be located in the hinged frame. The cubicle needs front and rear doors. The latter for the access to the cables.

Figure 5-4. Power Distribution (Cont.)



Attention

Front and rear doors are required. Special internal layout for ABB Master. Equipment is also required. Ribbon cables must not be tightened together with other cables. AccuRay equipment is very deep and cannot be located in the hinged frame.

Figure 5-5. Power Distribution (Cont.)

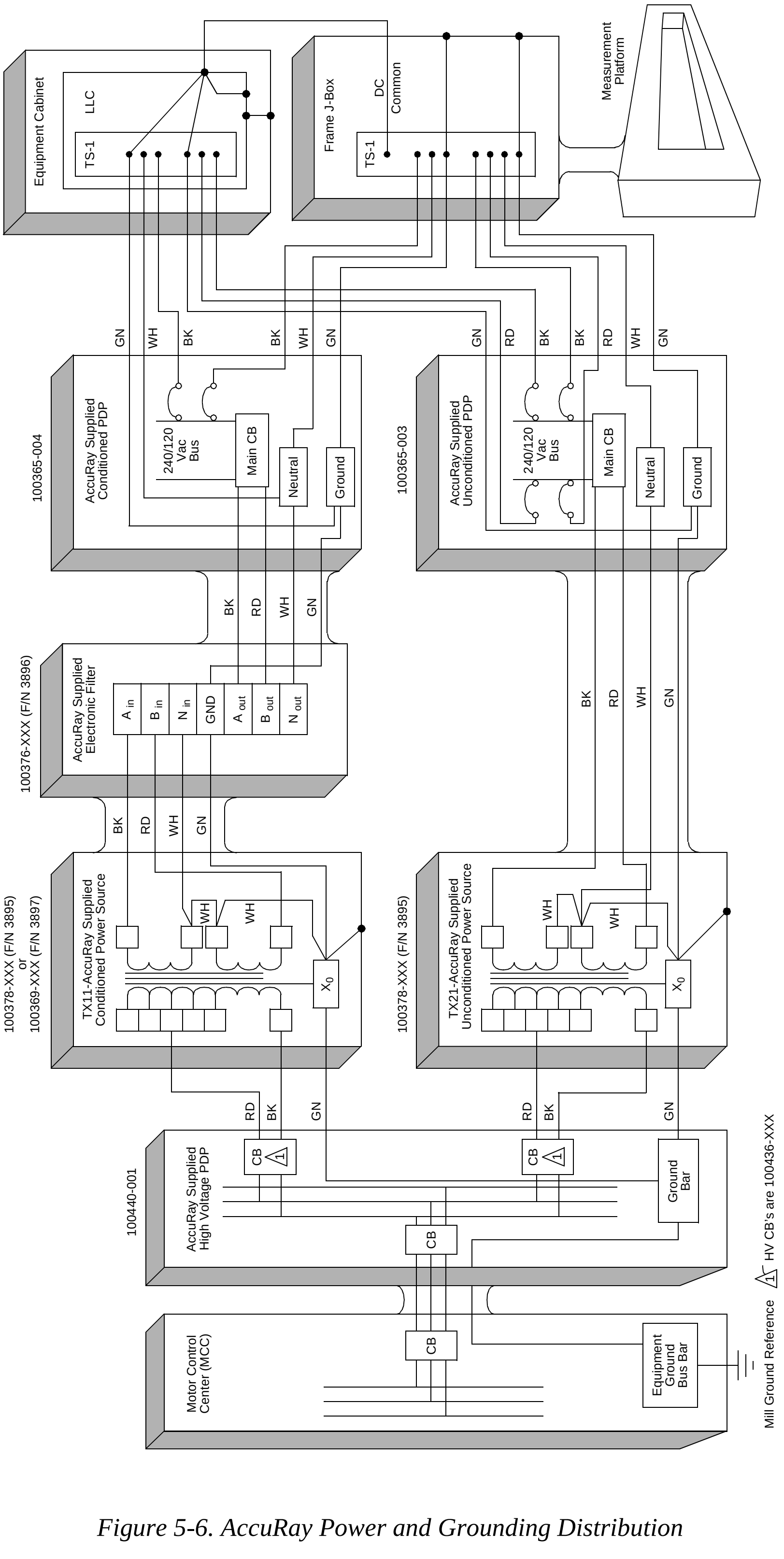


Figure 5-6. AccuRay Power and Grounding Distribution

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